PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PCT-2791	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. **PCT/KR2005/000650**	International filing date *(day/month/year)* **09 MARCH 2005 (09.03.2005)**	Priority date *(day/month/year)* 09 MARCH 2004 (09.03.2004)

International Patent Classification (IPC) or national classification and IPC

H01J 31/02(2006.01)i

Applicant

KOREA ATOMIC ENERGY RESEARCH INSTITUTE et al

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ (sent to the applicant and to the International Bureau) a total of 5 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demamd **10 OCTOBER 2005 (10.10.2005)**	Date of completion of this report 13 JUNE 2006 (13.06.2006)
Name and mailing address of the IPEA/KR Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer OH, Je Uk Telephone No. 82-42-481-8222

Form PCT/IPEA/409 (cover sheet) (April 2005)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/KR2005/000650

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☒ This report is based on translations from the original language into the following language English, which is the language of a translation furnished for the purposes of:

   ☐ international search (under Rules 12.3 and 23.1(b))

   ☒ publication of the international application (under Rule 12.4)

   ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

   ☐ the international application as originally filed/furnished

   ☒ the description:
   pages 1.2.5-10 as originally filed/furnished
   pages* 3,4 received by this Authority on 25/05/2006
   pages* received by this Authority on

   ☒ the claims:
   pages as originally filed/furnished
   pages* as amended (together with any statment) under Article 19
   pages* 11-13 received by this Authority on 25/05/2006
   pages* received by this Authority on

   ☐ the drawings:
   pages as originally filed/furnished
   pages* received by this Authority on
   pages* received by this Authority on

   ☐ the sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets
   ☐ the sequence listing *(specify)* :
   ☐ any table(s) related to sequence listing *(specify)* :

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets
   ☐ the sequence listing *(specify)*:
   ☐ any table(s) related to sequence listing *(specify)* :

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/KR2005/000650

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-13	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	1-13	YES
	Claims	NONE	NO
Industrial applicability (IA)	Claims	1-13	YES
	Claims	NONE	NO

2. Citations and explanations (Rule 70.7)

1. Subject-matter

The present invention relates to a large-area shower electron beam irradiator with field emitters as an electron source. The electron beam irradiator of the present invention comprises the following parts: a cylinder-shaped vacuum chamber which is formed with an electron beam irradiation window at one side of its circumference; a cathode in which a field emitter tip consisting of a carbon nanotube is formed; a high-voltage supplying unit for supplying high-voltage to the said cathode; a first support including a pin insert hole formed at one end of the cathode and a first insulator formed in the high voltage supply for the passage of a high voltage supply pin so that the high voltage supply pin is inserted into the pin insert hole of the cathode through the first insulator; and a second support including an insert groove formed in a second insulator longitudinally and axially located at the other end of the cathode inserted into the insert groove to support the cathode.

2. Reference is made to the following documents:

D1 : JP 09-166699 A (NISSIN HIGH VOLTAGE Co. Ltd.)
D2 : JP 2004-47254 A (TOSHIBA CORP.)

D1 invention comprises the following parts: a cylinder-shaped vacuum chamber which is formed with an electron beam irradiation window at one side of its circumference; a cathode consisting of an electron emitter; and high-voltage electrode for supplying high-voltage to the said cathode.
And D2 invention includes an electron beam device having a cathode composed of carbon nanotube.

The claimed invention meets the criteria set out in PCT Article 33(2)-(3) because the cited documents D1-D2 do not teach nor fairly suggest an electron beam irradiator comprising: a cylinder-shaped vacuum chamber which is formed with an electron beam irradiation window at one side of its circumference; a cathode in which a field emitter tip consisting of a carbon nanotube is formed; a high-voltage supplying unit; a first support including a pin insert hole formed at one end of the cathode and a first insulator; and a second support including an insert groove.

3. Claims 1-13 have industrial applicability under PCT Article 33(4), because the subject matter claimed can be made or used in industry.

field emitter tip formed on the cathode, corresponding to the beam irradiation window; a high voltage supply placed at one end of the vacuum chamber, and adapted to apply high voltage toward the cathode; a first support including a pin insert hole formed at one end of the cathode and a first insulator formed in the high voltage supply for the passage of a high voltage supply pin so that the high voltage supply pin is inserted into the pin insert hole of the cathode through the first insulator; and a second support including an insert groove formed in a second insulator longitudinally and axially located at the other end of the cathode so that an insert protrusion formed at the other end of the cathode is inserted into the insert groove to support the cathode.

Preferably, the field emitter tip is made of a carbon nanotube.

In the invention, the cathode is of a rod-shaped structure having a circular cross-section, and includes a field emitter tip shaped as a strip formed longitudinally in an outer periphery of the rod-shaped structure.

The electron beam irradiator may further comprise: fixing flanges integrally provided at both ends of the vacuum chamber; a first vacuum flange coupled with one of the fixing flanges, and having a high voltage supply; and a second vacuum flange coupled with the other one of the fixing flanges.

In the invention, the beam irradiation window may comprise: a base plate fixed to the vacuum chamber, slightly protruded from the vacuum chamber to the outside, and having an elongated rectangular slit formed in a central area thereof; a metal wire inserted into an insert groove formed in an outer periphery of the slit of the base plate; a metal foil placed on the metal wire, and having an area slightly larger than an area surrounded by the metal wire; and a cover plate coupled with the base plate, corresponding to the slit of the base plate, and having a beam irradiation slit corresponding to the slit in the central area of the base plate.

Preferably, the vacuum chamber is cylindrical, with a plurality of beam irradiation windows formed in an outer periphery thereof, and wherein the cathode placed inside the vacuum chamber has field emitter tips formed in an outer periphery of the cathode, corresponding to the beam irradiation windows of the vacuum chamber, respectively.

According to another aspect of the invention for realizing the above objects, it is provided an electron beam irradiator comprising: a vacuum chamber having a plurality of beam irradiation windows formed longitudinally in an outer peripheral area of the vacuum chamber; a cathode placed inside the vacuum chamber, and having at least one linear area formed thereon and a plurality of field emitter tips formed on the linear area, corresponding to the beam irradiation windows, respectively; a high voltage supply placed at one end of the vacuum chamber, and adapted to apply high voltage toward the cathode; a first support

including a pin insert hole formed at one end of the cathode and a first insulator formed in the high voltage supply for the passage of a high voltage supply pin so that the high voltage supply pin is inserted into the pin insert hole of the cathode through the first insulator; and a second support including an insert groove formed in a second insulator longitudinally and axially located at the other end of the cathode so that an insert protrusion formed at the other end of the cathode is inserted into the insert groove to support the cathode.

Preferably, the vacuum chamber has at least one linear area opposed in parallel to the linear area of the cathode, in which the beam irradiation windows are formed.

[Advantageous Effects]

As described above, the present invention provides an electron beam irradiator designed to irradiate electron beams in a wide area at a low energy by using field emitter tips so that electron beams can be irradiated in a wide area without using an electromagnet as well as in a high current density without using a heater such as a filament or an additional power supply, thereby ensuring a simplified structure as well as a reduced size.

Also, according to the invention, the electron beam irradiator, by using electron beams emitted from strip-shaped field emitter tips formed in a cathode, can rapidly cure ink or paint applied in a wide area as well as facilitates massive disinfection and sterilization of medical articles. Besides, according to the invention, the electron beam irradiator can be simply assembled and disassembled thereby enhancing the promptitude, simplicity and efficiency of assembly, substitution and maintenance.

In addition, according to the invention, the electron beam irradiator can minimize the distortion of an accelerated electric field of electron beams irradiated through a beam irradiation window while preventing the vacuum state of a vacuum chamber from damage through the beam irradiation window as well as to achieve a sufficient enduring force against the pressure difference between the vacuum and the air while minimizing the thickness of a metal foil through which the electron beams are irradiated thereby to decrease the loss of the electron beams and resultant energy loss through the metal foil.

Furthermore, according to the invention, the electron beam irradiator can form several beam irradiation windows in a single cylindrical unit in order to ensure independent application and high operation efficiency for the respective beam irradiation windows according to use, further raise treatment efficiency for the inside of a cylindrical object in particular, and enable current density adjustment according to the distance change between the irradiator and the object.

[CLAIMS]

[Claim 1]

An electron beam irradiator comprising:

a vacuum chamber having a beam irradiation window formed longitudinally in an outer periphery of the vacuum chamber;

a cathode placed centrally and longitudinally inside the vacuum chamber, and having a field emitter tip formed on the cathode, corresponding to the beam irradiation window;

a high voltage supply placed at one end of the vacuum chamber, and adapted to apply high voltage toward the cathode;

a first support including a pin insert hole formed at one end of the cathode and a first insulator formed in the high voltage supply for the passage of a high voltage supply pin so that the high voltage supply pin is inserted into the pin insert hole of the cathode through the first insulator;

and a second support including an insert groove formed in a second insulator longitudinally and axially located at the other end of the cathode so that an insert protrusion formed at the other end of the cathode is inserted into the insert groove to support the cathode.

[Claim 2]

The electron beam irradiator according to claim 1, wherein the field emitter tip is made of a carbon nanotube.

[Claim 3]

The electron beam irradiator according to claim 1, wherein the cathode is of a rod-shaped structure having a circular cross-section, and includes a field emitter tip shaped as a strip formed longitudinally in an outer periphery of the rod-shaped structure.

[Claim 4]

The electron beam irradiator according to claim 3, wherein the field emitter tip is formed along the circular cross-section of the cathode to radially emit electron beams.

[Claim 5]

The electron beam irradiator according to claim 1 or 3, further comprising:

fixing flanges integrally provided at both ends of the vacuum chamber;

a first vacuum flange coupled with one of the fixing flanges, and having a

high voltage supply; and

a second vacuum flange coupled with the other one of the fixing flanges.

[Claim 6]

The electron beam irradiator according to claim 5, wherein the second insulator of the second support has a plurality of prominences and depressions formed on the second insulator to extend surface passages thereof in order to prevent insulation breakdown under high voltage.

[Claim 7]

The electron beam irradiator according to claim 1, wherein the beam irradiation window comprises:

a base plate fixed to the vacuum chamber, slightly protruded from the vacuum chamber to the outside, and having an elongated rectangular slit formed in a central area thereof;

a metal wire inserted into an insert groove formed in an outer periphery of the slit of the base plate;

a metal foil placed on the metal wire, and having an area slightly larger than an area surrounded by the metal wire; and

a cover plate coupled with the base plate, corresponding to the slit of the base plate, and having a beam irradiation slit corresponding to the slit in the central area of the base plate.

[Claim 8]

The electron beam irradiator according to claim 1 or 3, wherein the vacuum chamber is cylindrical, with a plurality of beam irradiation windows formed in an outer periphery thereof, and wherein the cathode placed inside the vacuum chamber has field emitter tips formed in an outer periphery of the cathode, corresponding to the beam irradiation windows of the vacuum chamber, respectively.

[Claim 9]

The electron beam irradiator according to claim 8, wherein the electron beam windows are formed at both sides of the vacuum chamber to provide treatment to an object that moves linearly outside the vacuum chamber.

[Claim 10]

The electron beam irradiator according to claim 8, wherein the electron beam windows are formed at three sides of the vacuum chamber to provide treatment to an object that moves around the vacuum chamber.

[Claim 11]

The electron beam irradiator according to claim 8, wherein the electron beam windows are formed at four sides of the vacuum chamber to provide treatment to a cylindrical object while the vacuum chamber is rotated inside the cylindrical object.

[Claim 12]

An electron beam irradiator comprising:

a vacuum chamber having a plurality of beam irradiation windows formed longitudinally in an outer peripheral area of the vacuum chamber;

a cathode placed inside the vacuum chamber, and having at least one linear area formed thereon and a plurality of field emitter tips formed on the linear area, corresponding to the beam irradiation windows, respectively;

a high voltage supply placed at one end of the vacuum chamber, and adapted to apply high voltage toward the cathode;

a first support including a pin insert hole formed at one end of the cathode and a first insulator formed in the high voltage supply for the passage of a high voltage supply pin so that the high voltage supply pin is inserted into the pin insert hole of the cathode through the first insulator;

and a second support including an insert groove formed in a second insulator longitudinally and axially located at the other end of the cathode so that an insert protrusion formed at the other end of the cathode is inserted into the insert groove to support the cathode.

[Claim 13]

The electron beam irradiator according to claim 12, wherein the vacuum chamber has at least one linear area opposed in parallel to the linear area of the cathode, in which the beam irradiation windows are formed.